EXECUTION ALGORITHMS

OCTOBER 2014

version 2014-01-08

CONTENT

Why Execution Algorithms via NASDAQ OMX?

Overview of Initial Scope of Algorithms

Pricing Model

Legal Framework

How to Get Going - Next Steps

Algo Logics and training material

Algo Technical

Nasdaq

EXECUTIVE SUMMARY

Nasdaq* offers a set of traditional execution algorithms (Algos) via the INET Nordic trading system.

The cost efficient solution is provided through a partnership with a leading independent provider of broker-neutral algorithms and will be interfaced via INET Nordic FIX.

*via NASDAQ OMX Exchange and Clearing Services AB.

WHY EXECUTION ALGORITHMS VIA NASDAQ?

YOUR NEEDS

Achieve the best possible execution price based on your chosen strategy.

Minimize market impact and prevent information leakage for your large orders.

Easy access to liquidity across multiple trading venues via Nasdaq Nordic current smart order routing.

Nasdaq

WHY EXECUTION ALGORITHMS VIA NASDAQ?

OUR
UNIQUE
OFFERING

Nasdaq, the leader and pioneer in the exchange industry, offers a set of execution algorithms (Algos).

Available for all Exchange Members in Helsinki, Stockholm, Copenhagen and potentially later on also Iceland.

The Algorithmic Product Suite consists of classic single stock benchmark strategies and one pair trading

Nasdaq

WHY EXECUTION ALGORITHMS VIA NASDAQ OMX?

KEY BENEFITS

Cost efficient, pay-as-you go service based on shared co-located Algo installation

Use existing infrastructure and FIX connectivity.

Access to integrated smart order routing logic.

Fine tune and control Algo orders based on a set of user defined parameters.

Broker neutral.

Anonymity of parent order and protection against information leakage is key.

OVERVIEW OF INITIAL SCOPE OF ALGORITHMS

- **VWAP (Volume Weighted Average Price)** - Pre-trade schedule based on historical volumes.

- **TWAP (Time Weighted Average Price)** - Executes desired quantity at a constant rate.

- **PVOL (Percentage Of Volume)** - Targets a user-defined participation rate.

- **IMSH (Implementation Shortfall)** - Minimizes risk-adjusted trading costs relative to the arrival price.

- **CLOS** - Minimizes risk-adjusted trading costs relative to the closing price.

- **PNPR** - Targets relative performance of execution at or better than a specified basis point spread between a pair of stocks.

Nasdaq

PRICING MODEL

No start up fees, no fixed fees

- On top of the Regular Exchange fees, according to current price list, a variable fee based on executed turnover will come on top:

  - Additional variable Algo Service Fee expressed in basis points for all executions, regardless on where the executions take place.

  - The variable Algo Service Fee is 0,50 bps divided into two components:

    - 0,20 bps (VAT to be added) to NASDAQ OMX Exchange and Clearing Services AB

    - 0,30 bps to be paid to the Exchange for the use of the Exchange order routing service. Separate additional fee for Away market trades is included in this service fee.

NO START UP FEE   NO FIXED FEE
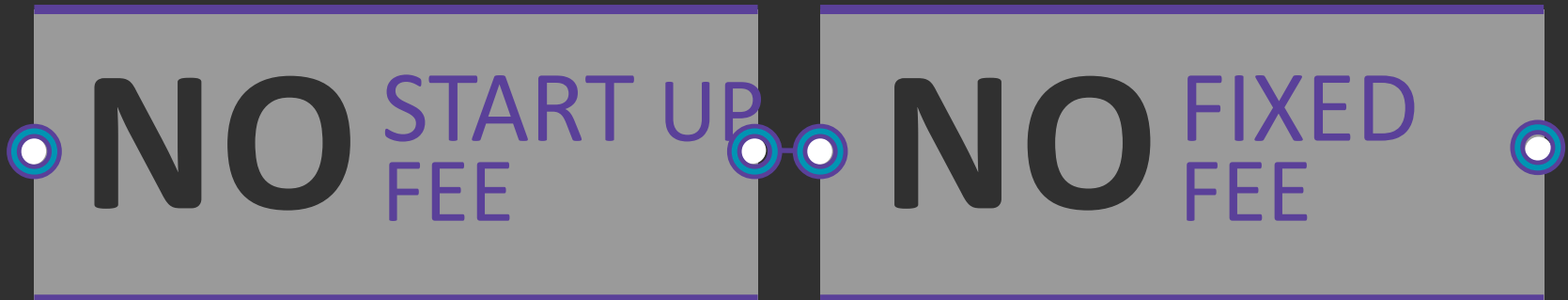
Nasdaq

LEGAL FRAMEWORK

NASDAQ OMX Exchange and Clearing Services AB will offer the Algo functionality to NASDAQ OMX Nordic Members in accordance with a separate service agreement.

NASDAQ OMX Exchange and Clearing Services AB is a non-regulated entity and is not offering any investment firm services. It is the responsibility of the Member to comply with the relevant ESMA Guidelines.

NASDAQ OMX Nordic Exchanges will provide service support through existing Member support channels.

The member must have signed NASDAQ OMX Nordic Routing agreement since the Algo engine can decide to send orders to Away markets according to the setup for our Smart Order Routing service.

Nasdaq

HOW TO GET GOING

NEXT STEPS

SERVICE AGREEMENT WITH NASDAQ OMX EXCHANGE AND CLEARING SERVICES AB.

ROUTING AGREEMENT WITH NASDAQ OMX NORDIC.

SECURE ISV READINESS OR USE NORDIC WORKSTATION.

ALGO LOGICS AND TRAINING MATERIAL

DESCRIPTION OF ALGOS - TWAP
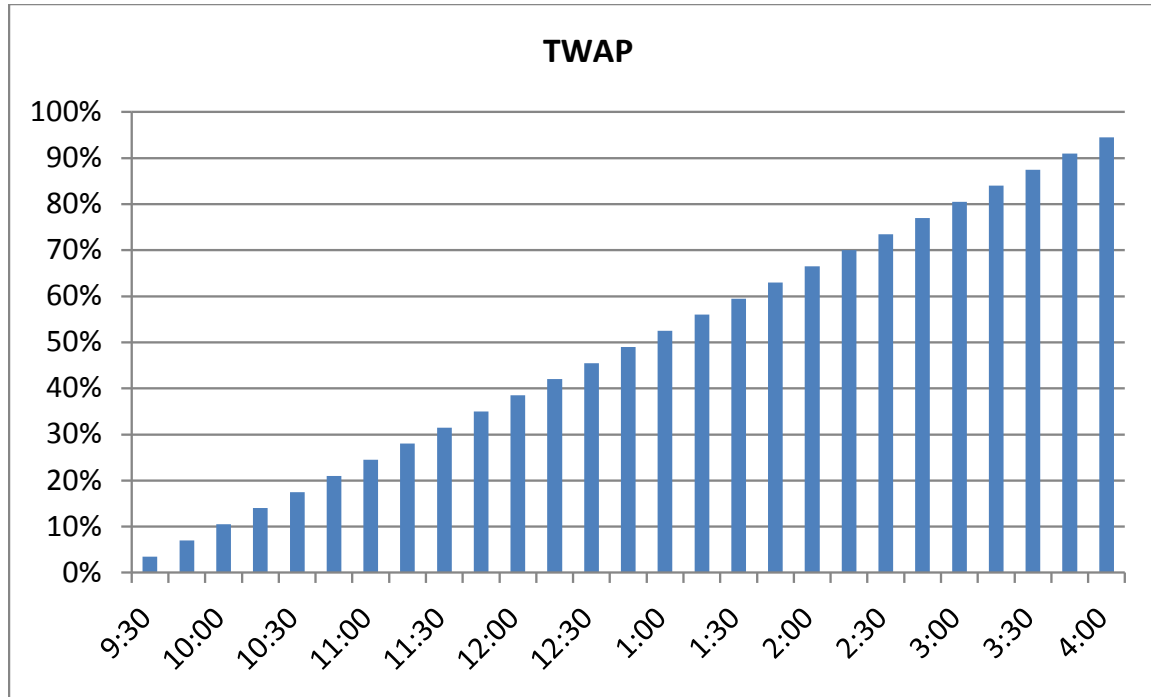
(time weighted average price)

TW AP

A relatively straightforward algorithm that executes the trade over a timeframe determined by the user. TWAP aims to trade at a constant rate over this interval (using stealth compression order placement model). This strategy is attractive to clients who want to stretch out their trading in a predictable manner.

"Spread it out over the day/number of hours"

Key parameters: Min and Max % Vol, I Would Price

TWAP

"Spread it out over the day/number of hours"

% of Order Finished

TWAP

DESCRIPTION OF ALGOS - VWAP

(volume weighted average price)

VWAP

"Match the volume-weighted average price over the day/number of hours"

Uses the historical volume pattern of a stock to determine a trading trajectory intended to track the volume weighted average price.

The VWAP strategy uses market volume patterns and the volume patterns of the individual stock to generate a robust volume pattern and trajectory. Stretching the trade out evenly over the volume pattern is an attractive strategy for those who seek to minimize risk toward the volume-weighted average price.
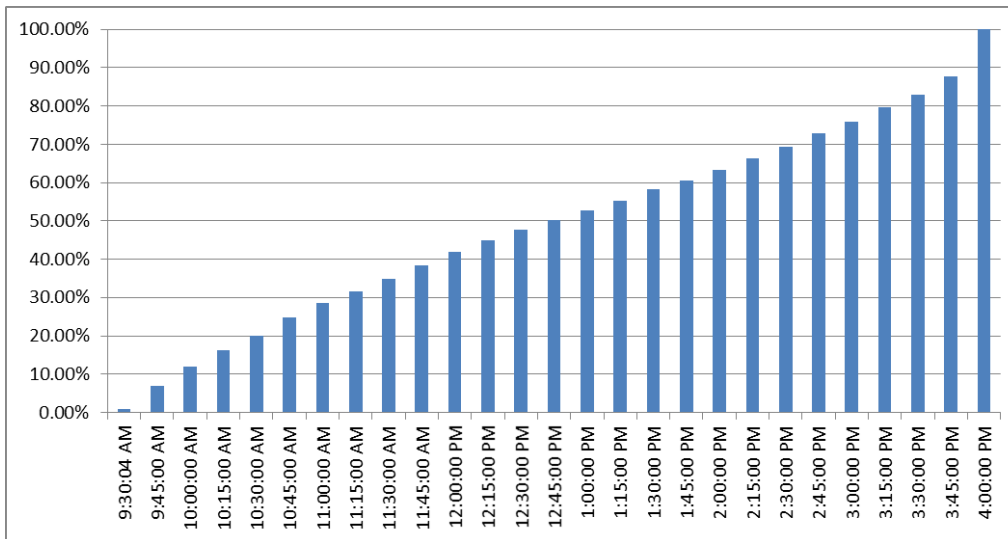
Key parameters: Min and Max % Vol, I Would Price

VWAP

"Match the volume-weighted average price over the day/number of hours"
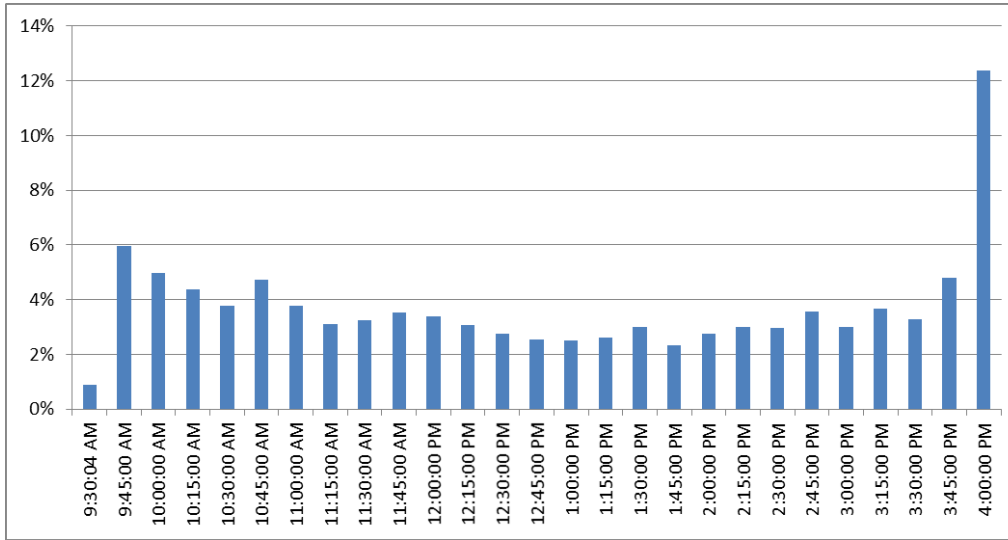
Execution over the day

% of Order Finished

DESCRIPTION OF ALGOS - PVOL

(percentage of volume)

PVOL

"Be X percent of the volume"

The PVOL algorithm attempts to minimize market impact by participating in a constant, user-decided percentage of trading volume over a time interval. Includes support for building the PVOL strategy by dynamically adjusting target market participation rate as a function of real-time market conditions relative to a chosen benchmark

In contrast to VWAP, however, PVOL does not create a trajectory from historical data, but tracks and reacts to the fluctuations of market volume in real-time.

The intent of the PVOL algorithm is to set an upper bound on the trade's market impact by maintaining a certain level of market participation (TargetPctVol parameter).

The PVOL strategy offers an intuitive tradeoff between predictable impact and risk. Setting a higher percent of volume will produce greater market impact but attenuate risk; targeting a lower percent of volume will delay execution and increase price risk.

Key parameters: Target % Vol, Min & Max % Vol, Block Filter, I Would Price

PVOL

"Be X percent of the volume"
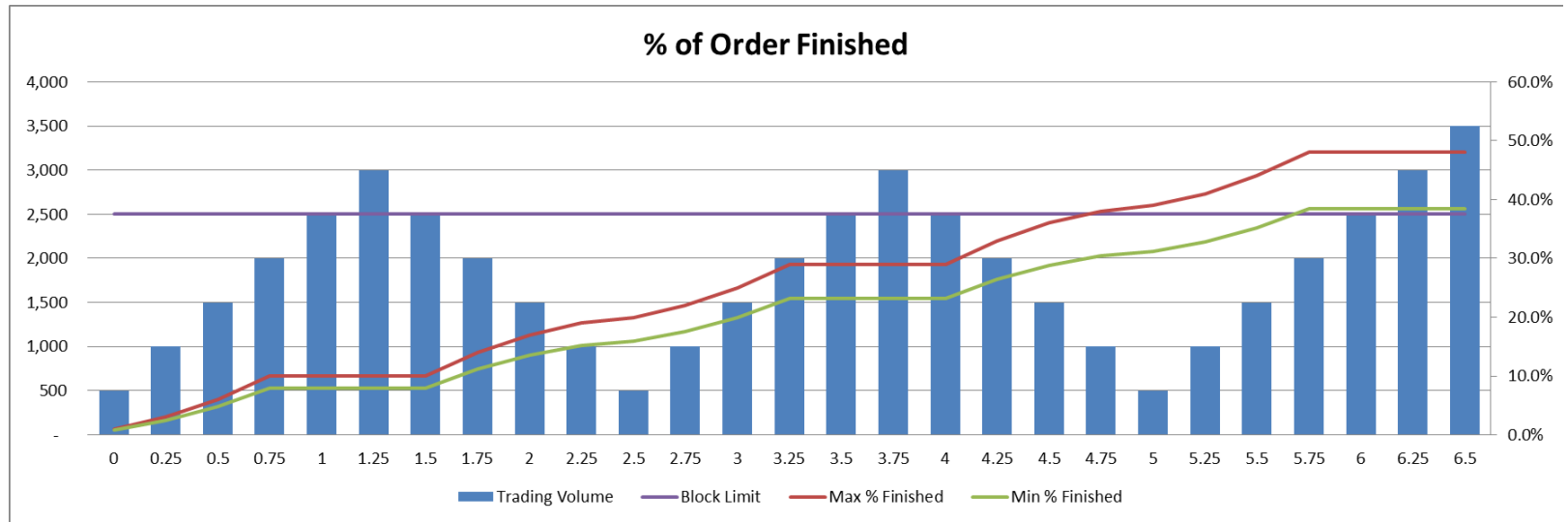
DESCRIPTION OF ALGOS - IMSH

(implementation shortfall)

IMSH

"Be as close to the arrival price as possible and adjust aggression in response to market conditions"

Minimizes the risk-adjusted trading costs relative to the arrival price of the stock and dynamically adjusts aggression as a function of real-time market conditions relative to a chosen benchmark.
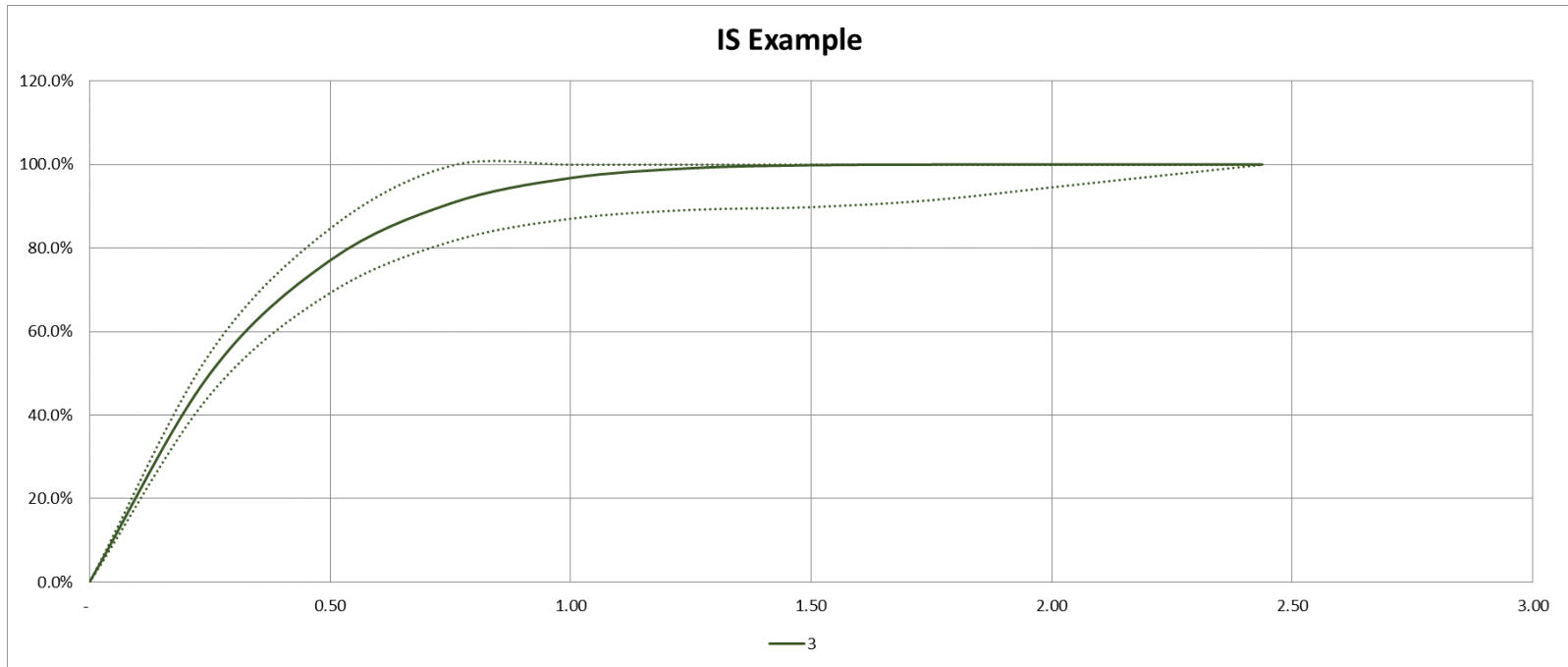
This front weighted trajectory tends to result in an average execution price close to the arrival price while minimizing implementation shortfall.

Key parameters:

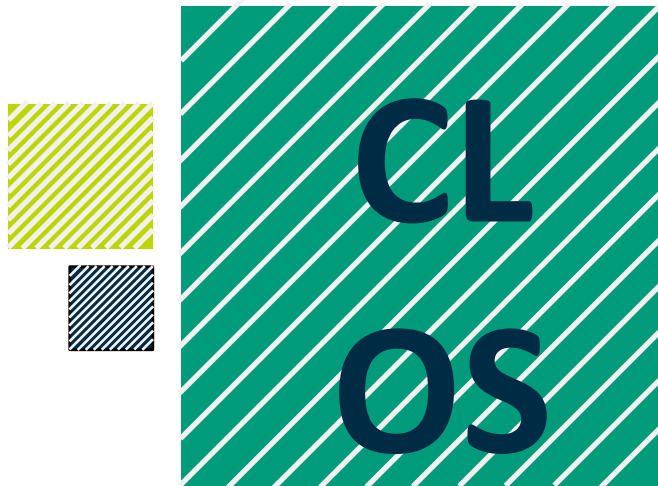Min & Max % Vol, I Would Price, Dynamic Benchmark

IMSH

"Try to beat the arrival price and adjust aggression in response to market conditions"

IS Example

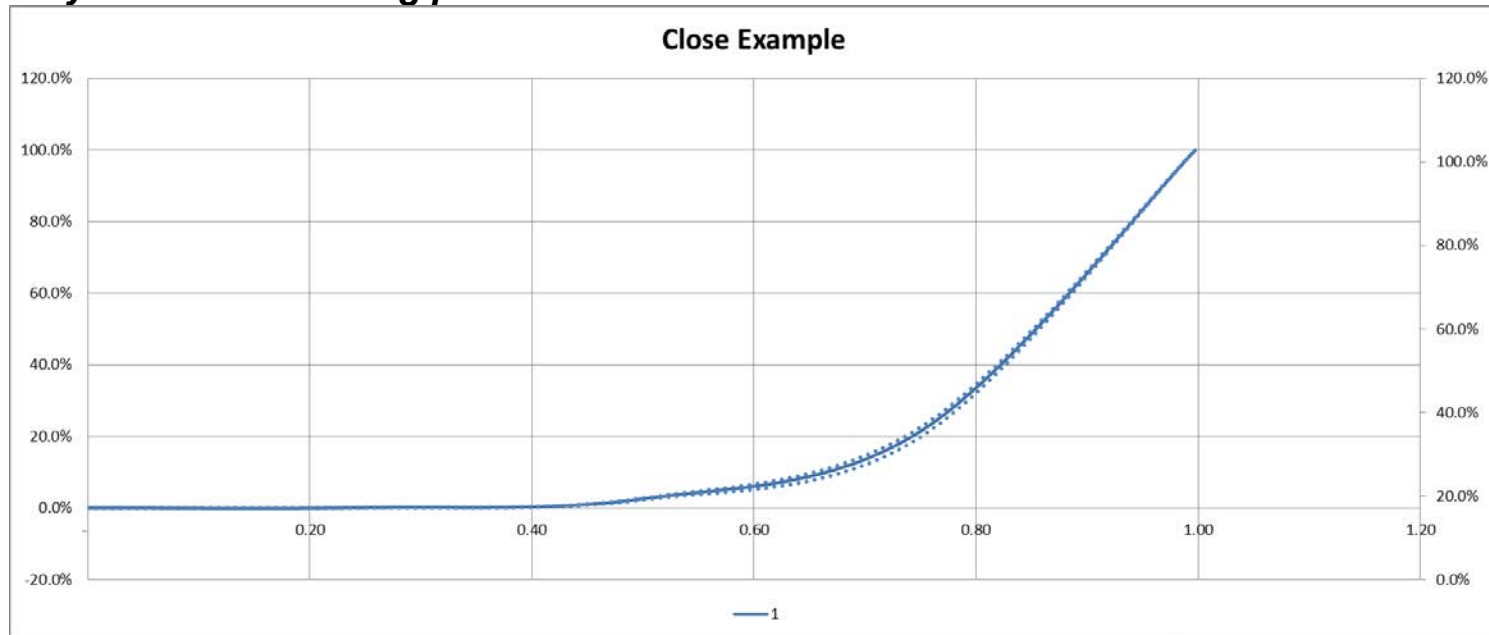*% of Order Finished*

DESCRIPTION OF ALGOS - CLOS

CLOS

"Try to beat the closing price"

Minimizes risk-adjusted trading costs relative to the closing price of the stock. This back weighted trajectory tends to result in an average execution price close to the price of the trade's completion while minimizing costs.

Key parameters:

Aggression, Min & Max % Vol, I Would Price, On Close Quantity.

Nasdaq

"Try to beat the closing price"

Close Example

% of Order Finished

Nasdaq

DESCRIPTION OF ALGOS - PNPR

(Performance Neutral Pair)

PN PR

"Executes when the relative changes are in line between the two legs – 'relative' from each legs Reference Price"

Mechanical trading strategy allowing to trade stocks in pair based on the relative price difference between the two stocks.

Market neutral strategy, which involves buying one stock while simultaneously selling (or shorting) another. The strategy allows one leg to be ahead or behind the other leg.
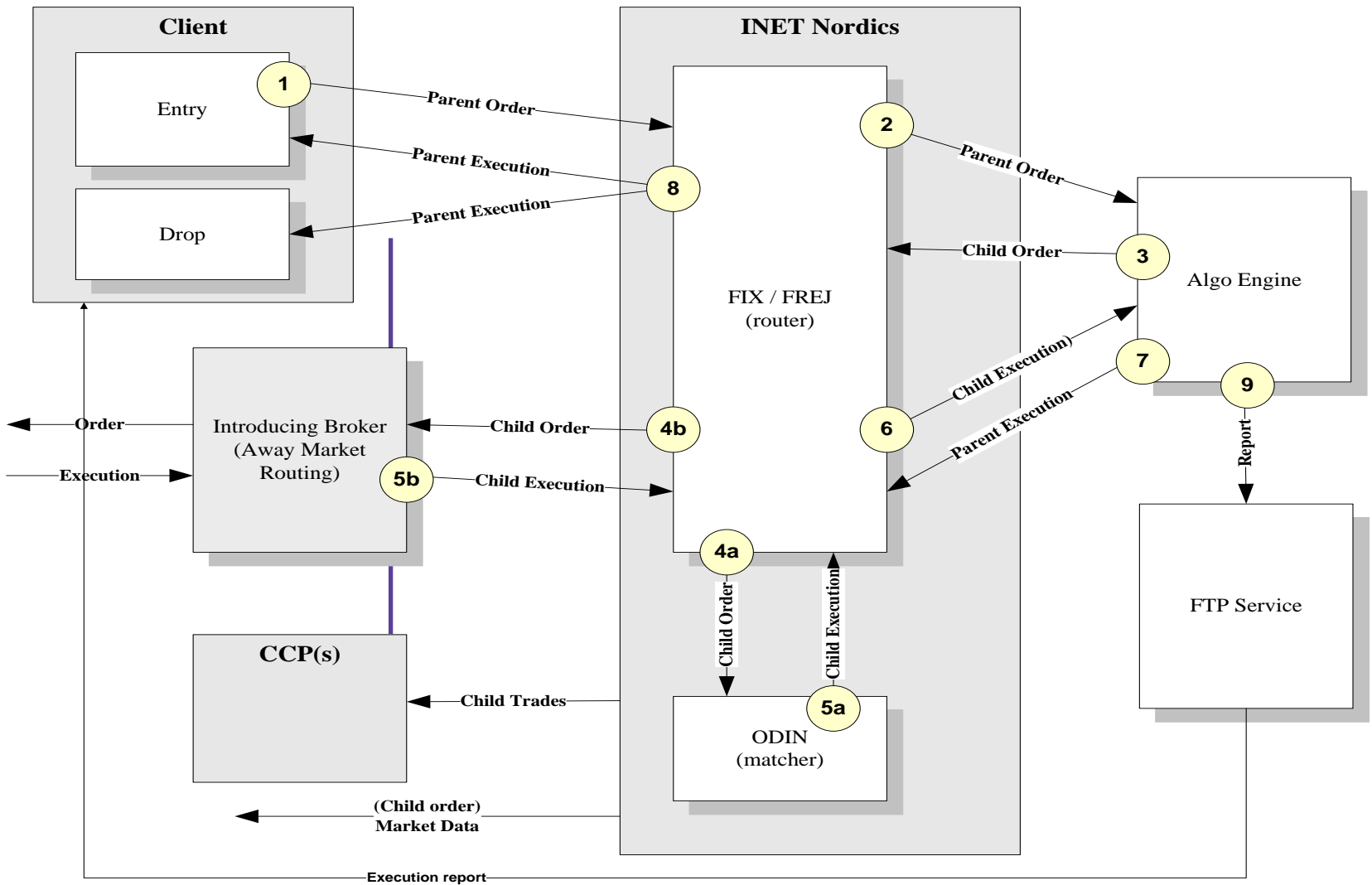
Key parameters:

Spread Limit, Reference price, Lag, Lead

PNPR

$$\frac{Price_{BuyLeg} - RefPx_{BuyLeg}}{RefPx_{BuyLeg}} \leq \frac{Price_{SellLeg} - RefPx_{SellLeg}}{RefPx_{SellLeg}} - \frac{SpreadLimit}{10000}$$

TECHNICAL SETUP

STEP BY STEP

(1) Algo "parent" orders are entered over the FIX Order Entry connection (or via Nordic Workstation) by the client and sent to INET Router (FREJ). Parent orders provide the mechanism that allows client to request Algos and for INET to report executions back to the client. The Parent is not a "real" order to the market.

(2) INET Router passes those "parent" orders into the Algo engine.

(3) The Algo engine sends "child" orders back to INET Router.

(4) INET Router sends based on instruction from Algo engine child orders to (4a) INET Matcher or (4b) after being Smart Order Routed to Away markets for execution. Although child orders are in the name of the client, they are not exposed to the member by INET.

(5) Child executions are gathered by INET Router.

(6) Child orders are the ones that technically trade, clear and settle and that are published in the market data feed. The child executions are sent to Algo engine and to CCP for clearing. Child executions are not relayed as such to clients.

(7) Algo Engine sends Parent execution to INET Router.

(8) INET Router sends parent executions back to the client. Separate FIX drop for Child orders and linkage to Parent order is available.

(9) End of day execution quality report available for the client on a FTP server.

Nasdaq